2006
KANSAS WATER QUALITY ASSESSMENT
(305(b) REPORT)

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Kansas Department of Health and Environment
Division of Environment
Bureau of Environmental Field Services
Suite #430
1000 SW Jackson
Topeka, Kansas 66612-1367

PART I: EXECUTIVE SUMMARY

This report, the 2006 Kansas Water Quality Assessment, presents a formal analysis of the state's overall water quality condition as required by section 305(b) of the federal Clean Water Act (33 USC 466 et seq.). Guidance provided by the US Environmental Protection Agency (EPA) for preparing this document affords several options. The Kansas Department of Health and Environment (KDHE) has elected to provide EPA an electronic water quality database accompanied by a brief written report. This abbreviated report summarizes major technical findings and changes in water quality assessment methodologies and criteria that have occurred since the publication of the previous (2004) 305(b) report.

The 2006 Kansas Water Quality Assessment considers four years of stream chemistry monitoring data (2002-2005), five years of stream biological monitoring data (2000-2004), six years of lake and wetland monitoring data (2000-2005), and three years of fish tissue contaminant data (2002-2004). Collectively, this information allows technical conclusions to be drawn concerning the water quality of 18,493 miles of streams and 245,227 acres of publicly owned (or publicly accessible) lakes and wetlands. This corresponds to approximately 60% of the state's classified stream mileage and 95% of the state's classified lake and wetland acreage.

Methodologies employed in the analysis of this information comply with the intended application of the Kansas surface water quality standards, with the following qualifications: (1) only narrative biological criteria and acute (as opposed to chronic) chemical criteria have been applied in the assessment of aquatic life support; (2) fish and shellfish consumption advisories have been considered in addition to published chemical criteria for the food procurement use; and (3) recreational use support has been evaluated on the basis of geometric mean concentrations of *Escherichia coli*, even where limited (bimonthly) sampling frequencies have precluded the calculation of these concentrations in strict accordance with prescribed regulatory procedures.

Data collected by KDHE during this reporting cycle indicate that 53% of the state's assessed stream mileage fully supports all designated uses, 7% is fully supported but threatened for at least one use, and 39% is impaired for one or more uses. Approximately 15% of assessed lake acreage fully supports all uses, whereas 76% is impaired for one or more designated uses. Sixteen percent of wetland acres either fully support all uses or lack sufficient data to evaluate conditions; the remaining 84% are impaired for one or more uses. Major causes of nonsupport for streams, in order of prevalence, are organic enrichment, high salinity, elevated pH, and elevated *E. coli* concentrations. Major causes for lakes and wetlands include elevated nutrient levels, eutrophication, siltation, high turbidity, and taste and odor problems.

Sources primarily responsible for pollutant loadings and beneficial use impairments in Kansas streams include agriculture (irrigated and nonirrigated crop production; intensive animal feeding operations), natural phenomena (e.g., mineralized groundwater intrusion), and habitat degradation. Agriculture, municipal point sources, and natural phenomena are the primary factors contributing to water quality impairments in lakes. Approximately 61% of the state's assessed lake acreage has exhibited no change in trophic condition in recent years. Another 28% has experienced a measurable increase in trophic state and 4% has exhibited some improvement in trophic condition.

The renovation of many wastewater treatment facilities across the state continues to produce noticeable improvements in surface water quality. As the number of point sources contributing to water quality impairments declines, attention will increasingly shift to nonpoint sources. It is

anticipated that watershed pollution control efforts, predicated largely on the development and implementation of total maximum daily loads (TMDLs), will play an increasingly important role in the abatement of nonpoint source pollution in Kansas.

PART II: BACKGROUND

Updated background information for the Kansas 305(b) report is presented in the following tables:

Table 1. Kansas Atlas
Table 2. Number of Active KWPC and NPDES Permits
Table 3. Permit Compliance Record
Table 4a. 319 Program Project History
Table 4b. Summary of Local Environmental Code Adoption through 2005
Table 5. KDHE Cooperative Funding for Construction of Municipal Wastewater Treatment Facility Upgrades and Expansions

Table 1. Kansas Atlas

TOPIC	VALUE
State population	2,744,687*
State surface area in square miles	81,778
Number of major river basins	12
Classified stream miles	30,620
Classified lakes (publicly owned or publicly accessible)	321
Classifed lake acres (publicly owned or publicly accessible)	189,258
Classified wetland acres (publicly owned or publicly accessible)	55,969

*Estimate 7/2005, US Census Bureau

Table 2. Number of Active KWPC and NPDES Permits*

NUMBER OF PERMITTED FACILITIES					
Municipal and Commercial		**Industrial/Federal**		**Agricultural**	
Total Municipal and Commercial KWPC (non-overflowing)	434	Total Industrial/ Federal KWPC (non-overflowing)	87	Agricultural NPDES	437
Discharging Lagoons	341	Total Industrial (discharging)	494	Agricultural State	1,131
Mechanical Treatment Facilities	162	Pretreatment	51	Agricultural Certifications	1,443
Municipal Stormwater	57				
TOTAL	**994**		**632**		**3,011**

KWPC = Kansas Water Pollution Control * as of January 1, 2006
NPDES = National Pollutant Discharge Elimination System

Table 3. Permit Compliance Record. "Absolute" Compliance* for WWTFs Excluding Non-Discharging Lagoons.

YEAR	TYPE OF FACILITY	
	MUNICIPAL & COMMERCIAL	**INDUSTRIAL**
2003	87%	95%
2004	86%	97%
TOTAL NUMBER	**503**	**494**

WWTF = Wastewater Treatment Facility
*Absolute compliance means that the facility reported all information required by the permit and certified that all permit limits were met during the monitoring period.

Nonpoint Source Pollution Control

Nonpoint Source (NPS) Implementation - Kansas' goal is to assure implementation of recommended water quality protection measures by all nonpoint pollutant sources. Implementation is facilitated through informational exchange and education, financial assistance, technical assistance, technology transfer, and enforcement where mandatory water quality protection measures are established. Implementation, administration and facilitation are accomplished through the coordination and collaboration of state, local and federal agencies and private sector organizations.

Information and Education - The goal of the NPS Public Information Program is to inform and educate Kansans concerning the value of the State's water resources. The program emphasizes prevention of nonpoint source pollution, rehabilitation of polluted waters, and an understanding of the requirements and objectives of the Kansas NPS Pollution Control Program.

Technical Assistance - Some Section 319 grant funds are used to support technical assistance activities of partner organizations. Recipients include, but are not lilmited to, the Kansas Rural Center Clean Water Farms program, the Kansas Alliance for Wetlands and Streams (KAWS), and the Watershed Specialists program for the abatement of water contamination by fecal coliform bacteria..

Technology Transfer -Technology transfer involves identifying activities and practices that if implemented will reduce the quantity of pollutants released or discharged from nonpoint pollutant sources, assessing and evaluating the effectiveness of these practices, and training designers, technical assistance providers, and owners of nonpoint pollutant sources in how and when to use these technologies.

Watershed Restoration and Protection Strategy (WRAPS) - The Watershed Restoration and Protection Strategy is a locally driven planning process that endeavors to identify the water quality protection and restoration needs of eight-digit hydrological unit code (HUC8) watersheds. This strategy serves to integrate habitat restoration and protection activities and TMDL implementation, water quality restoration, water quality protection, source water protection, and wellhead protection activities required under the Safe Drinking Water Act.

Table 4a. 319 Program Project History (1992 through 2005).

PROJECT TYPE	NUMBER OF PROJECTS	TOTAL (DOLLARS EXPENDED)
Information and Education	152	4,845,234.98
Technical Assistance	180	8,935,272.53
Technology Transfer	39	1,754,200.00
WRAPS	109	8,326,345.23
TOTAL	**480**	**23,861,052.74**

Local Environmental Protection Program (LEPP) - The LEPP, administered by KDHE and funded by the Kansas Water Office (KWO) under the auspices of the State Water Plan, provides financial assistance to local governmental units to develop and implement a local environmental protection plan. The authorizing statute requires the local environmental protection plan to include a sanitary code and to provide plans to address subdivision water and wastewater, solid waste, hazardous waste, public water supply protection, and NPS pollution. Presently, 101 of 105 Kansas counties are participating in the program. Environmental code adoption has been a priority effort since the beginning of the program.

Table 4b. Summary of Local Environmental Code Adoption through 2005

STATUS	NUMBER
Adopted and being Administered	101
Approved for Adoption	2
Being Developed	0
No Action	2

Source Water Assessment Program - The 1996 amendments to the Safe Drinking Water Act required each state to develop a Source Water Assessment Program (SWAP). Additionally, each state was required to develop a Source Water Assessment (SWA) for each public water supply that treats and distributes raw source water. In Kansas, there are approximately 763 public water supplies that required SWAs. A SWA includes the following: delineation of the source water assessment area; inventory of potential contaminant sources; and susceptibility analysis. The SWA must also be made available to the public. KDHE's Watershed Management Section has implemented the Kansas SWAP plan, and all SWAs are completed. Final SWAs are available online at http://www.kdheks.gov/nps/ swap/.

On a statewide level, 54 percent of the 677 groundwater public water supplies (PWSs) received a low susceptibility analysis score, 45 percent received a moderate score, and 1 percent received a high score. Also on a statewide basis, 51 percent of the surface water PWSs received low scores, 43 percent received moderate scores, and 6 percent received high scores.

The Safe Drinking Water Act did not require protection planning to be part of the SWAP process. On a voluntary basis, KDHE encourages public water supplies and their surrounding communities to use the SWAs as the foundation for future protection planning efforts. The agency's source water protection specialist provides planning technical assistance, public outreach, and coordination of source water protection planning efforts statewide.

Table 5. KDHE Cooperative Funding for Construction of Municipal Wastewater Treatment Facility Upgrades and Expansions. Monetary units given in millions of dollars.

FEDERAL FUNDING YEAR (FFY)	KWPCRF*		CDBG**		RD***	TOTAL
	Basic	Leveraged	Federal	Match	Federal	Match
2004	46.261	62.269	4.759	5.847	1.450	120.586
2005	16.868	28.101	3.068	3.129	4.197	55.363
TOTAL	**63.129**	**90.370**	**7.827**	**8.976**	**5.647**	**175.949**

* KWPCRF= Kansas Water Pollution Control Revolving Fund
** CDBG = Community Development Block Grant
*** RD = Rural Development Grants and Loans

PART III: SURFACE WATER ASSESSMENT

Water quality monitoring and assessment programs within KDHE are administered by the Division of Environment's Bureau of Environmental Field Services (BEFS) and Bureau of Water (BOW), with analytical support from the Division of Laboratories, computer programming and networking assistance from the Office of Information Systems, and consultative input from the Division of Health. The department also works cooperatively with various other agencies and organizations in the acquisition and interpretation of water quality data. Routine monitoring operations are implemented by the BEFS Technical Services Section, which maintains offices in downtown Topeka and employs nine full-time environmental scientists and two full-time environmental technicians. Six district offices are maintained by BEFS, and two of these, located in Dodge City and Hays, assist with the collection of water quality samples from sites in far western Kansas.

Stream Chemistry Monitoring Program

The stream chemistry monitoring program is the largest and longest running environmental monitoring operation administered by the BEFS Technical Services Section. Water samples are obtained routinely from streams throughout Kansas (Figure 1) and analyzed for a large suite of physical, organic, inorganic, radionuclide and bacteriological parameters (Appendix A). The program database currently comprises over two million records representing nearly 400 active and inactive monitoring locations and approximately 100 different analytical parameters. Some records in the database date to the late 1960s, and several monitoring sites have a continuous period-of-record extending from that time to the present.

Currently, the stream chemistry sampling network is comprised of 320 monitoring sites spanning all the major river basins and physiographic regions of Kansas. About 165 core sites are visited by staff on a bimonthly basis every year, whereas the remaining 155 sites are monitored using a four-year rotational approach; i.e., samples are collected bimonthly from approximately 25 percent of these sites each year. Sampling stations have been chosen to represent water quality conditions in specifically targeted watersheds or stream reaches. For example, some sites reflect water quality conditions in streams as they enter or exit Kansas, others represent conditions above or below major discharging facilities, urban areas, or reservoirs, and still others reflect water quality conditions in predominantly rural watersheds. A few "minimally altered" and several "least impacted" reference streams have been included in the network to gain a better understanding of baseline water quality conditions in the various ecoregions of Kansas. Stream reaches hosting monitoring sites range in size from first to eighth order on the Strahler scale. As currently configured, the network provides water quality information useful in the characterization of pollutant loadings from more than 97 percent of the state's contributing drainage area. Many monitoring sites are located near the lower terminus of HUC8 watersheds and play an important role in the development and refinement of TMDLs for 303(d)-listed streams.

Appendix B summarizes the assessment methodology applied to stream chemistry and microbiological data obtained during the most recent (2002-2005) 305(b) reporting cycle.

Stream Biological Monitoring Program

This program examines the structural attributes of aquatic macroinvertebrate assemblages and utilizes this information to provide a more refined picture of the ecological status of streams in Kansas. Unlike water chemistry measurements alone, which reflect conditions occurring at the moment of sample collection, biological monitoring provides an integrated measure of environmental condition over time frames ranging from weeks to years, depending on the biological assemblage of interest. The KDHE aquatic macroinvertebrate database currently contains some 52,000 high resolution (predominantly genus/species level) records, and a separate freshwater mussel database contains more than 9,000 high resolution records. For taxonomic confirmation and training purposes, mussel shell specimens represented in the database are permanently archived by BEFS, and all general macroinvertebrate samples are retained in storage for a minimum of five years.

The macroinvertebrate sampling network includes 180 monitoring sites distributed throughout the state. Samples normally are obtained from 60-65 sites each year, including 45 core stations and 15-20 rotational stations sampled three consecutive years per rotation. The remaining sites in the sampling network represent short-term monitoring stations that are visited by staff on a sporadic basis as dictated by TMDL development needs or other regulatory considerations. As weather conditions allow, monitoring activities at all sites adhere to a seasonal rotation to reduce statistical bias and provide a more comprehensive picture of the resident macroinvertebrate communities; i.e., samples are collected during the spring of one year, the summer of the next, and the fall of the next, a cycle that is repeated every three years (core sites) or every rotational sequence. Streams hosting core or rotational monitoring sites range in size from second to eighth order on the Strahler scale; approximately 50 percent of these sites are located on fifth or sixth order streams and 80 percent are located on fourth to seventh order streams. The sampling network incorporates a targeted monitoring strategy comparable to that employed in the stream chemistry monitoring program. However, a greater proportion of core sites in the biological monitoring program are located on minimally impacted or least impacted reference streams.

Stream macroinvertebrate data from 2000 to 2004 and freshwater mussel data from 1995 to 2004 were considered during the development of this 305(b) report (Figure 2). The overall level of aquatic life support in each monitored stream reach was determined using a suite of four or, in some instances, five biological metrics, including the macroinvertebrate biotic index (MBI), Kansas biotic index (KBI-NO), Ephemeroptera-Plecoptera-Trichoptera (EPT) index, EPT % abundance, and mussel community loss index. The latter index was utilized only if (a) mussel surveys had been performed by KDHE in a given stream reach on at least three separate occasions and (b) the stream reach was known to have supported at least five mussel species in the past. Evaluations for metrics that increase with declining water quality (MBI and KBI) were based on the five-year 75^{th} percentile values, whereas evaluations for two metrics that decrease with declining water quality (EPT, EPT % abundance) were based on five-year 25^{th} percentile values. Assessment (use support) thresholds for these various metrics are presented in the following table.

Table 6. Aquatic life use support categories and diagnostic thresholds

Category	MBI	KBI-NO	EPT	EPT Abundance	Mussel% Loss
Full support	≤ 4.5	≤ 2.60	≥ 13	≥ 48%	≤ 10%
Partial	4.51-5.39	2.61-2.99	12-8	47-31%	11-25%
Non-support	≥ 5.4	≥ 3.0	≤ 8	≤ 30%	≥ 26%

In general, reaches with fewer than five observations were deemed partially supportive or nonsupportive of the aquatic life use only if the available data ensured (mathematically) an aggregate five-year score consistent with this determination. If the calculated aggregated score for a stream reach closely approached a break point, assessment personnel considered historical water quality trends, previous use support determinations, and adequacy of data before arriving at a final use support determination. Assigned causes and sources were based on the size and proximity of upstream point sources, point source performance, dominant land uses within the watershed and near the sampling location, and any instream physical manifestations relating to degraded water quality (silt blanketing of sediments, large growths of filamentous or mat forming algae, effluent odors, etc.).

Fish Tissue Contaminant Monitoring Program

This program generates information on contaminant levels in fish collected from streams and lakes in Kansas. Whole-fish samples (composite samples of three to six individuals) are obtained from nine long-term monitoring sites, transferred to the EPA laboratory in Kansas City, and analyzed for organochlorine pesticides, polychlorinated biphenyls, toxic metals, and other bioaccumulative contaminants. Resulting data are used to track the occurrence of these contaminants within the ecological food web and ascertain temporal and spatial trends in environmental condition. Composite fillet samples also are obtained from selected water bodies and analyzed by KDHE and EPA laboratories for contaminants of potential human health concern. In consultation with the Kansas Department of Wildlife and Parks (KDWP), KDHE staff evaluate the contaminant data to determine the need for issuing, rescinding, or modifying local fish consumption advisories. The fish tissue database now comprises approximately 13,400 records, representing 80 sites and more than 200 (79 detected) contaminant parameters (Appendix A).

Fish tissue samples normally are obtained each year from 15-20 water bodies across the state (Figure 3). Sampling efforts focus primarily on streams and lakes with known water quality problems and existing fish consumption advisories. Although chlordane traditionally has been viewed as the contaminant of greatest, chlordane concentrations in fish have declined dramatically in recent years and attention has shifted gradually to mercury, polychlorinated biphenyls, and a few other persistent contaminants. The agency recently has devoted a greater proportion of its monitoring resources and laboratory sample allocation to the collection and analysis of larger predatory fish from recreational reservoirs. This initiative acknowledges national trends in mercury levels in freshwater fish and the potential for mercury-related health problems, especially in more vulnerable segments of the human population (e.g., children and women of child bearing age).

In the development of this 305(b) assessment, all streams and lakes in Kansas with existing fish consumption advisories were considered nonsupportive of the food procurement use. Conversely, all classified waterbodies lacking advisories were considered fully supportive of this use. Most advisories were based originally on the collection and analysis of at least three duplicate (six total) composite fish samples collected over a three-year period. Fish consumption advisories were developed following EPA guidelines and risk assessment methodologies. Specifically, fish contaminants rated as carcinogens were evaluated on the basis of average documented concentrations, EPA cancer potency factors, and an assigned population risk of 1:100,000. Further assumptions included lifetime exposure, average adult body weight, and eight-ounce meal portions. Noncarcinogens were evaluated on the basis of median contaminant levels and EPA's RfD and hazard index (> 1) values. Risk calculations for children were based on average body weight at 12 years and four-ounce meal portions. Calculations for adults were based on average body weight and eight-ounce meal portions.

Lake and Wetland Monitoring Program

This program surveys water quality conditions in publicly owned and publicly accessible lakes and wetlands throughout Kansas. Individual water bodies are visited by staff on a three- to five-year rotational schedule, and field measurements and subsequent laboratory analyses provide data on a large suite of physical, organic, inorganic and biological (i.e., bacteria, phytoplankton and macrophyte) parameters (Appendix A). The program's primary database now contains more than 250,000 analytical records representing more than 300 water bodies. Watersheds associated with many of these monitored lakes and wetlands are periodically surveyed with respect to prevailing land use/land cover and the location and size of any discrete pollutant sources (wastewater treatment plants, feedlots, etc.). Macrophyte community composition and aerial macrophyte coverage also are evaluated in selected water bodies smaller than 300 acres. Information derived from these ancillary activities improves the department's ability to estimate contaminant fluxes, characterize lake trophic conditions, predict future changes in these conditions, and assess the need for regulatory intervention.

Water quality information currently is obtained from 120-130 lakes and wetlands distributed throughout the state (Figure 4). These include all 24 federal reservoirs, most state-administered fishing lakes (those retaining open water in most years), various other state, county or locally owned lakes, several privately owned but publicly accessible lakes, and seven state or federally owned marshes. Because only a few of these water bodies are naturally occurring, an effort has been made to identify reservoirs in minimally disturbed or least disturbed watersheds to serve the function of reference systems. This program routinely shares a large amount of data and expertise with other agencies and organizations involved in lake and wetland management, environmental restoration, water quality monitoring, and environmental education. Additional collaborative efforts have addressed the abatement of toxic algal blooms and taste/odor problems in public drinking water supply reservoirs.

Lakes and wetlands routinely included in this program are regarded as "monitored" systems for the purposes of the 305(b) report. During the 2000 - 2005 reporting cycle, additional waterbodies were subjected to less intensive investigation and regarded as "evaluated" systems. These included several smaller lakes from which a single grab sample was collected and analyzed for major cations and anions, nutrients, and chlorophyll-a. In other cases, additional physicochemical and biological data were obtained and/or a watershed survey was conducted by the department.

Pursuant to Section 314(a)(2) of the federal Clean Water Act, a stand-alone assessment of all monitored and evaluated lakes in Kansas has been appended to this 305(b) assessment (Appendix C).

FIGURE 1: STREAM CHEMISTRY MONITORING NETWORK
2002 – 2005

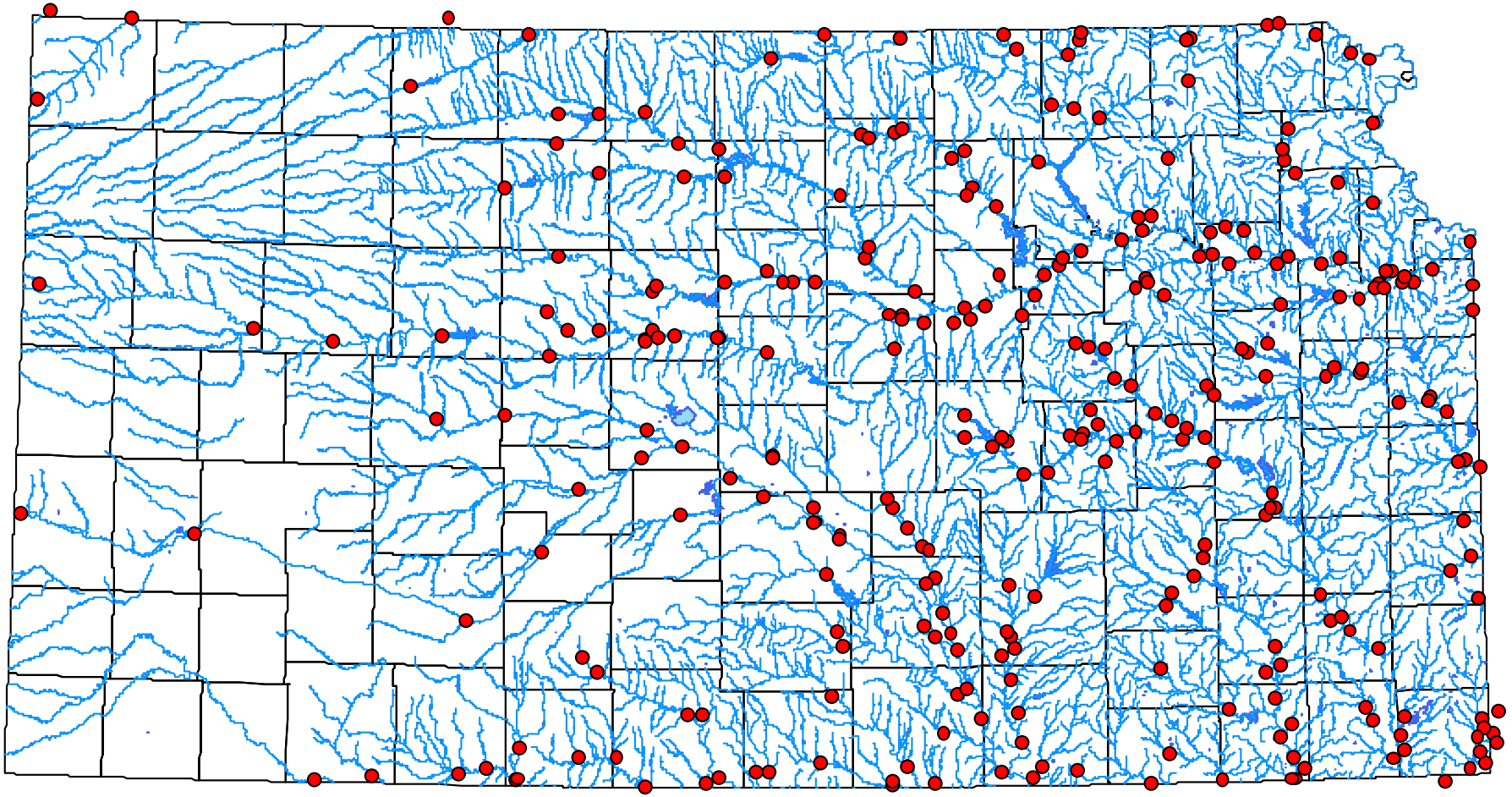


FIGURE 2: STREAM BIOLOGICAL MONITORING NETWORK

2000 – 2004

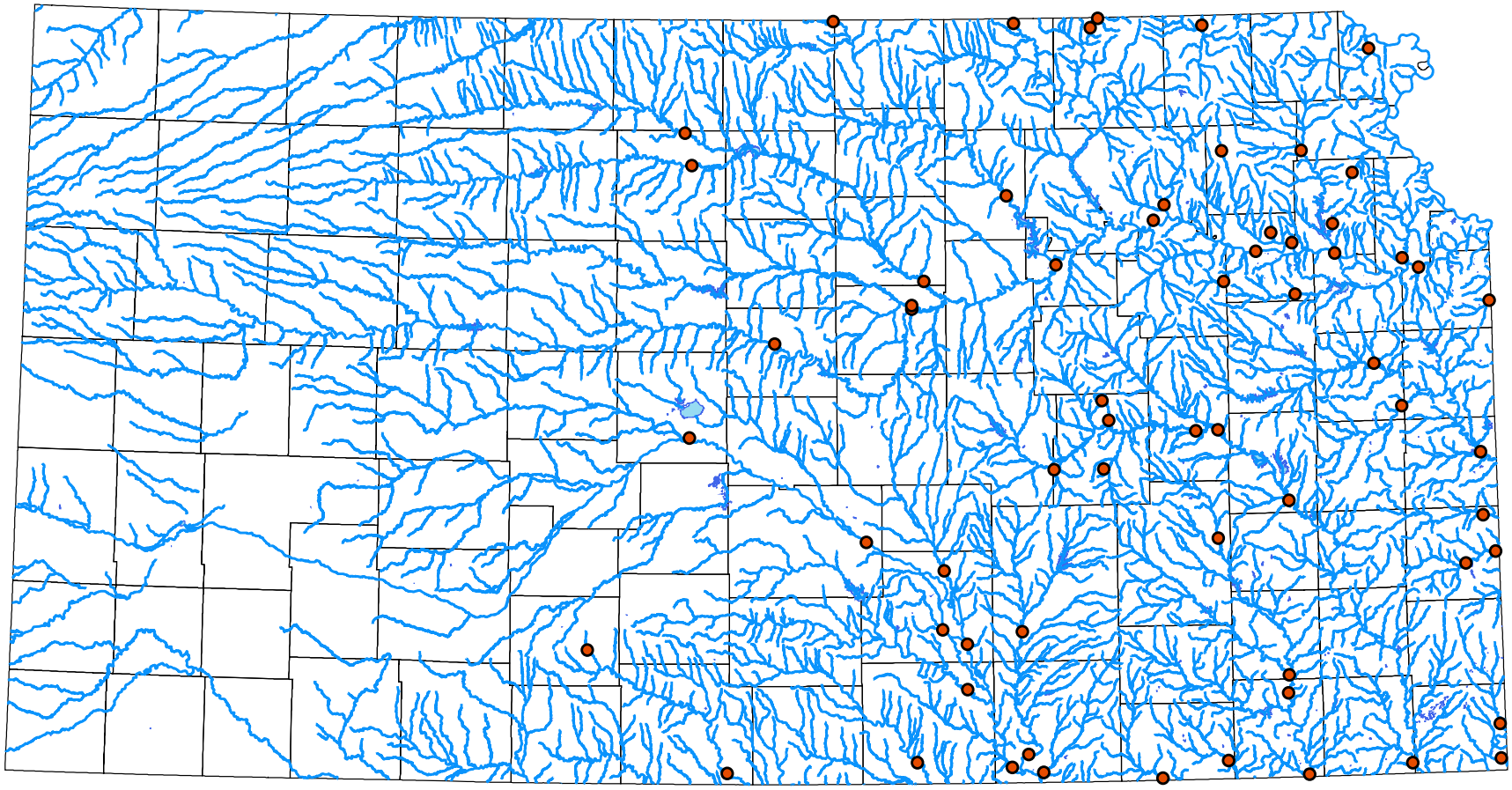


FIGURE 3: STREAM AND LAKE FISH TISSUE COLLECTION SITES
2002 – 2004

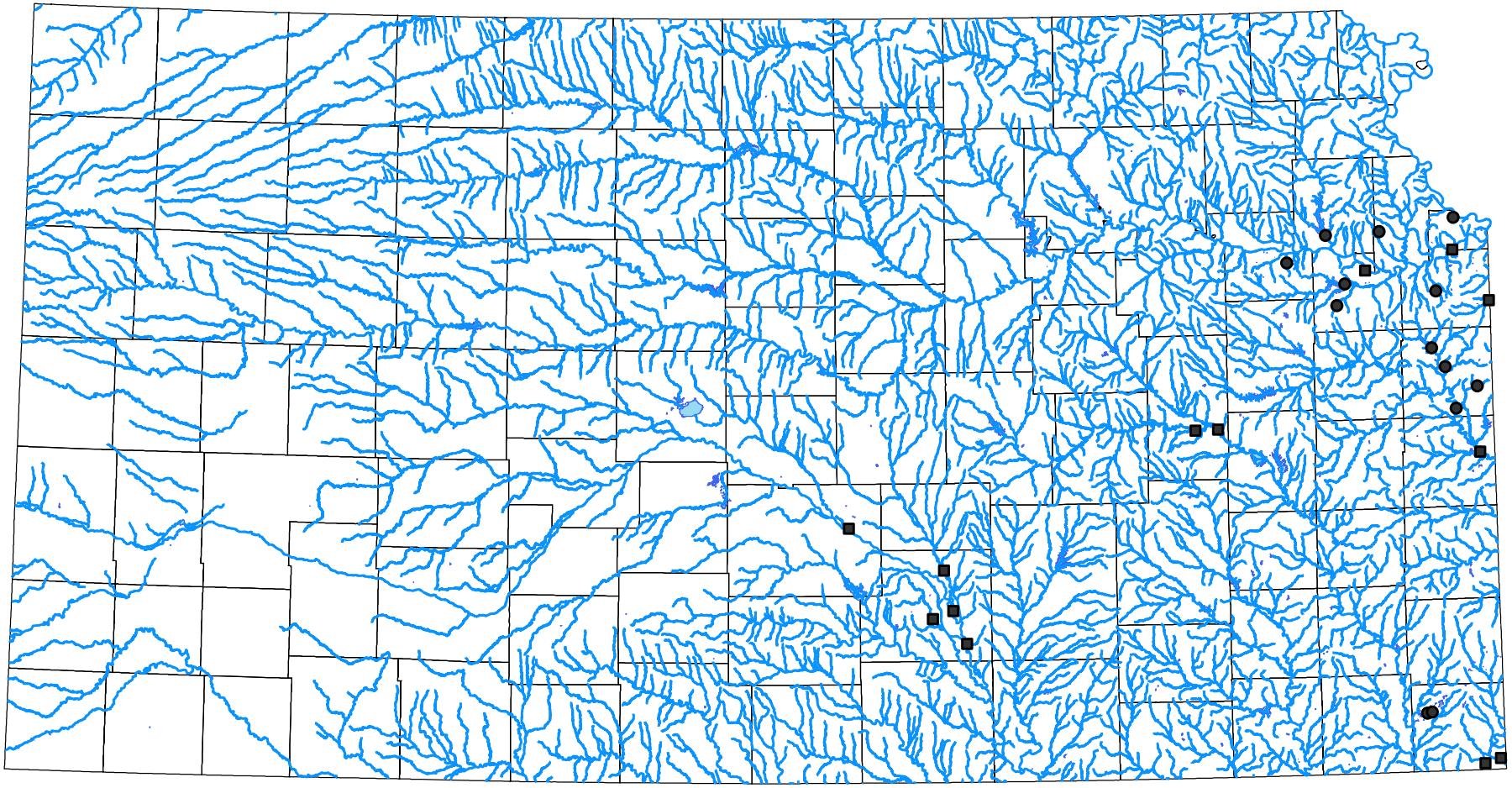
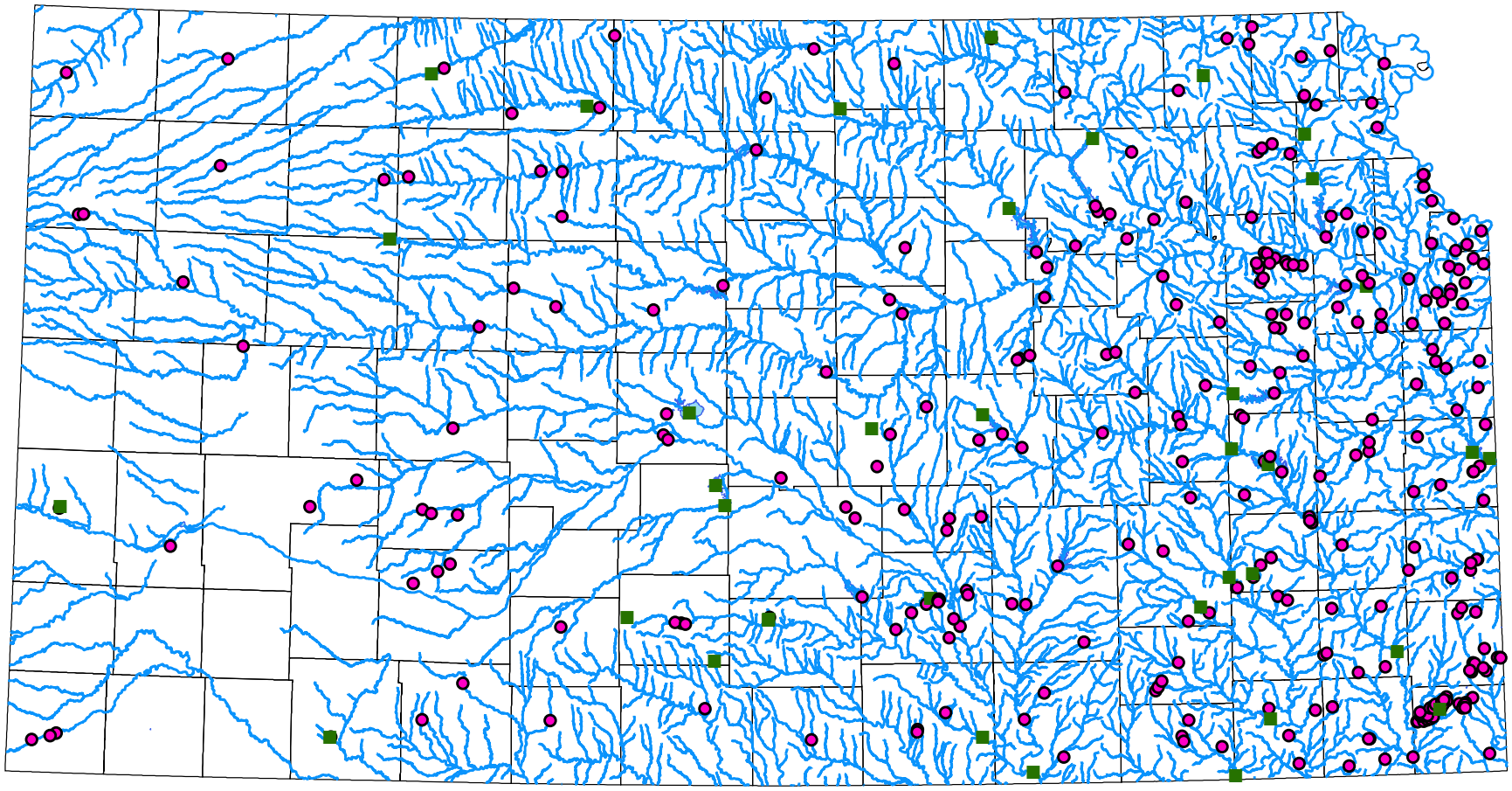


FIGURE 4: LAKE AND WETLAND MONITORING NETWORK

2000 – 2004



Supplemental Tables

Additional summary tables, although not required, have been provided as follows:

Table 7a.	Summary of Fully Supporting, Threatened and Impaired Streams
Table 7b.	Summary of Fully Supporting, Threatened and Impaired Lakes
Table 8a.	Individual Use Support Summary for Streams
Table 8b.	Individual Use Support Summary for Lakes
Table 9a.	Total Assessed Stream Mileage Impaired by Cause Categories
Table 9b.	Total Assessed Lake Acres Impaired by Cause Categories
Table 10a.	Total Assessed Stream Mileage Impaired by Source Categories
Table 10b.	Total Assessed Lake Acres Impaired by Source Categories
Table 11.	Trophic Status of Lakes Assessed during Reporting Cycle
Table 12.	Trophic State Trends in Lakes
Table 13a.	Summary of Domestic Water Supply Use Impairments in Streams
Table 13b.	Summary of Domestic Water Supply Use Impairments in Lakes

Table 7a. Summary of Fully Supporting, Threatened and Impaired Streams (in miles)

DEGREE OF USE SUPPORT	ASSESSMENT CATEGORY		TOTAL ASSESSED
	EVALUATED	MONITORED	
Size Fully Supporting All Assessed Uses	0	9,892	9,892
Size Fully Supporting All Assessed Uses but Threatened for at Least One Use	0	1,299	1,299
Size Impaired for One or More Uses	0	7,302	7,302
TOTAL SIZE ASSESSED	**0**	**18,493**	**18,493**

Table 7b. Summary of Fully Supporting, Threatened and Impaired Lakes (in acres)

DEGREE OF USE SUPPORT	ASSESSMENT CATEGORY		TOTAL ASSESSED
	EVALUATED	MONITORED	
Insufficient Data	2,095	225	2,320
Fully Supporting of all uses	1,086	26,814	27,900
Threatened for one or more uses (but not impaired any uses)	325	14,859	15,184
Size impaired for one or more uses	10,199	133,655	143,854
Total size assessed	**13,705**	**175,553**	**189,258**

Table 8a. Individual Use Support Summary for Streams (in miles)

GOALS	USE	SIZE ASSESSED	SIZE FULLY SUPPORTING	SIZE THREATENED	SIZE PARTIALLY SUPPORTING	SIZE NOT SUPPORTING
PROTECT AND	Aquatic Life (acute only)	18,477	11,763	0	4,588	2,126
PROTECT AND ENHANCE PUBLIC HEALTH	Fish Consumption	408	255	*	*	152
	Shell fishing	*	*	*	*	*
	Primary Contact (not including swimming beaches)	10,609	8,340	2,135	*	133
	Secondary Contact Recreation	5,734	5,723	11	*	0
	Domestic Water Supply	1,051	894	0	0	157
SOCIAL AND ECONOMIC	Agricultural (state defined below)	*	*	*	*	*
	Cultural or Ceremonial	*	*	*	*	*
	State Defined 1. Irrigation 2. Livestock	7,483 7,589	7,185 6,932	* *	11 191	287 466

* = category not applicable

Table 8b. Individual Use Summary for Lakes (in acres)

GOALS	USE	SIZE ASSESSED	SIZE FULLY SUPPORTING / SIZE THREATENED	SIZE PARTIALLY SUPPORTING	SIZE NOT SUPPORTING	INSUFFICIENT DATA
Protect & Enhance Ecosystems	Aquatic Life (acute criteria)	189,258	102,113 / 12,932	67,034	4,859	2,320
Protect & Enhance Public Health	Fish Consumption**	189,258	185,816 / 0	671	531	2,240
	Shellfishing	*	*	*	*	*
	Primary Contact	189,258	45,714 / 21,552	115,599	4,073	2,320
	Secondary Contact	189,258	127,165 / 13,106	43,372	3,295	2,320
	Domestic Water Supply	189,258	36,104 / 21,685	87,539	41,610	2,320
Social & Economic Enhancement	Agricultural (irrigation)	189,258	140,731 / 22,502	15,211	8,494	2,320
	Agricultural (livestock)	189,258	145,547 / 22,506	15,226	3,659	2,320
	Cultural	*	*	*	*	*

* = category not applicable ** = based on fish consumption advisories and food procurement criteria

TABLE 9a. Total Assessed Stream Mileage Impaired by Cause Categories

CAUSE CATEGORY	MILEAGE IMPAIRED	
	MAJOR	MODERATE/MINOR
Cause unknown	6	12
Unknown toxicity	*	*
Pesticides	0	0
Priority organics	*	*
Nonpriority organics	*	*
Metals (Cadmium, Copper, Selenium, Zinc)	105	110
Ammonia	0	0
Cyanide	*	*
Sulfates (Livestock watering)	623	166
Chlorine	*	*
Other inorganics (Boron, Beryllium, Fluoride)	127	0
Nutrients**	69	0
pH	226	1,945
Siltation**	218	540
Organic enrichment/low DO	1,143	2,462
Salinity/TDS/chlorides/sulfates	954	154
Thermal modifications	0	332
Flow alterations	*	*
Other habitat alterations	0	0
Pathogen indicators	133	2,163
Radiation	0	0
Oil and grease	*	*
Taste and odor	*	*
Suspended solids	*	*
Noxious aquatic plants (macrophytes)	*	*
Total toxics	*	*
Turbidity	*	*
Exotic species	*	*
Excessive algal growth	*	*
Inappropriate littoral vegetation	*	*

* category applicable, but available data and/or criteria are insufficient
** based on biological site assessments only; geographical scope of impacts probably larger than indicated

Table 9b. Total Assessed Lake Acres Impacted by Cause Categories

CAUSE CATEGORY	ACREAGE IMPAIRED	
	MAJOR	MODERATE/MINOR
Cause unknown	0	0
Unknown toxicity	-	-
Pesticides	112	4,888
Priority organics	-	-
Nonpriority organics	-	-
Metals	0	18,513
Ammonia	-	-
Chlorine	-	-
Other inorganics (boron or fluoride)	41	5,390
Nutrients/eutrophication	26,107	123,461
pH	547	4,835
Siltation	*	*
Organic enrichment/low DO	66	43,716
Salinity/TDS/chlorides	111	37,409
Thermal modifications	-	-
Flow alterations	448	3,621
Other habitat alterations	-	-
Pathogen indicators	0	0
Radiation	-	-
Oil and grease	-	-
Taste and odor**	28,080	*
Suspended solids***	42,784	16,838
Noxious aquatic plants	264	167
Total toxics	-	-
Turbidity***	42,784	16,838
Exotic species	0	8,000
Other: perchlorate	128	0

- Category applicable but available data/criteria are insufficient.
* Statewide problem but no direct measurements are available
** Reflects problems severe enough to request KDHE assistance. Most incidents go unreported.
*** Based on multiple metrics

TABLE 10a. Total Assessed Stream Mileage Impaired by Source Categories

SOURCE CATEGORY	CONTRIBUTION TO IMPAIRMENT	
	MAJOR	MODERATE/MINOR
Industrial Point Sources	84	33
Municipal Point Sources	512	735
Combined Sewer Overflows	10	61
Collection System Failure	25	22
Domestic Wastewater Lagoon	*	*
Agriculture	2,457	5,124
Crop-related sources	2,026	3,012
Grazing-related sources	903	4,483
Intensive Animal Feeding Operations	936	3,325
Silviculture	*	*
Construction	0	8
Urban Runoff/Storm Sewers	179	249
Resource Extraction	1,086	257
Land Disposal	38	115
Hydromodification	1,031	881
Habitat Modification (non-hydromod)	1,033	4,024
Marinas and Recreational Boating	*	*
Erosion from Derelict Land	*	*
Atmospheric Deposition	27	0
Waste Storage/Storage Tank Leaks	*	*
Leaking Underground Storage Tanks	*	*
Highway Maintenance and Runoff	*	*
Spills (Accidental)	*	*
Contaminated Sediments	11	43
Debris and Bottom Deposits	*	*
Internal Nutrient Cycling (primarily lakes)	*	*
Sediment Resuspension	*	*
Natural Sources	2,320	4,076
Recreational and Tourism Activities	*	*
Salt Storage Sites	7	20
Groundwater Loadings	*	*
Groundwater Withdrawal	1,211	498
Other	0	0
Unknown Source	0	0
Sources Outside State Jurisdiction/Borders	193	94

* category applicable, but available data are insufficient

Table 10b. Total Assessed Lake Acres Impaired by Source Categories

SOURCE CATEGORY	CONTRIBUTION TO IMPAIRMENT	
	MAJOR	MODERATE/MINOR
Industrial Point Sources	-	-
Municipal Point Sources	25,627	120,789
Combined Sewer Overflows	-	-
Agriculture	49,798	108,209
Silviculture	-	-
Construction	-	-
Urban Runoff/Storm Sewers	413	12,083
Resource Extraction	0	1,201
Land Disposals	-	-
Hydromodification	3,533	5,990
Habitat Modification	-	-
Marinas	-	-
Atmospheric Deposition	0	627
Contaminated Sediments	-	-
Unknown Source	0	0
Natural Sources*	10,132*	30,656*
In-Lake Management Techniques**	254	45
Other (specify)	-	-

- Category applicable but available are data insufficient

* Refers mainly to in-lake ecophysiological processes, wind resuspension phenomena, and weather variations, with little background pollution loading from watersheds (except for instances of excessive waterfow)

** Some in-lake management techniques, (e.g., aerators; algal control efforts) can impair water quality in other ways.

Table 11. Trophic Status of Lakes Assessed during Reporting Cycle (% of total in parentheses)

TROPHIC STATUS	NUMBER OF LAKES	ACREAGE OF LAKES
Argillotrophic	16 (5.0)	41,865 (22.1)
Oligo-Mesotrophic	13 (4.0)	405 (0.2)
Mesotrophic	32 (10.0)	11,522 (6.1)
Slightly Eutrophic	44 (13.7)	55,541 (29.3)
Fully Eutrophic (Eutrophic)	61 (19.0)	60,368 (31.9)
Very Eutrophic	36 (11.2)	13,542 (7.2)
Low Hypereutrophic	38 (11.8)	1,657 (0.9)
High Hypereutrophic	38 (11.8)	1,726 (0.9)
Dystrophic	0	0
Unknown	43 (13.4)	2,632 (1.4)
TOTAL	321 (100.0)	189,258 (100.0)

Table 12. Trophic State Trends in Lakes (% of total in parentheses)

CATEGORY	NUMBER OF LAKES	ACREAGE OF LAKES
Assessed for Trends	321(100%)	189,258 (100%)
Improving	4(1.2%)	6,917(3.7%)
Stable	103 (32.1%)	115,906 (61.2%)
Degrading	36 (11.2%)	53,277 (28.2%)
Trend Unknown	178 (55.5%)	13,158 (6.9%)

Table 13a. Summary of Domestic Water Supply Use Impairments in Streams

Total Stream Mileage Designated for Use: **12,199** **Total Stream Mileage Monitored for Drinking Water Parameters: 7,813** **Total Stream Mileage Monitored for Drinking Water with Point of Diversion: 1,051*****			
	Miles	**Percent**	**Major Causes**
Fully Supporting Use	894	85	
Fully Supporting Use but Threatened	*	*	
Partially Supporting Use	0	0	
Not Supporting Use	157	15	sulfate** chloride**
Total Assessed for Use	1,051	100	

* not applicable
** secondary MCLs;
*** pursuant to K.A.R. 28-16-28e(c)(3)(A), domestic water supply criteria are applied only at existing points of water diversion

Table 13b. Summary of Domestic Water Supply Use Impairments in Lakes

Total Lake Acreage Designated For Use: 182,783 **Total Lake Acreage Assessed For Use: 189,258**			
	Acres	**Percent**	**Major Causes**
Insufficient Data	928 (2,320)	0.5 (1.2)	
Fully Supporting Use	35,051 (36,104)	19 (19)	
Threatened but Fully Supporting	21,670 (21,685)	12 (11.5)	
Partially Supporting Use	85,403 (87,539)	48 (46)	eutrophication chloride* sulfate*
Not Supporting Use	39,731 (41,610)	22 (22)	eutrophication atrazine chloride* sulfate*
Total Assessed For Use	182,783 (189,258)	100 (100)	

* secondary MCLs

PART IV: GROUNDWATER

Kansas no longer maintains a statewide groundwater quality monitoring program, and funding for the renewal of such an enterprise appears unlikely in the near future. However, an earlier monitoring program (suspended in 2002 owing to budgetary constraints) evaluated groundwater quality at more than 200 sites in Kansas. Individual wells in the monitoring network were sampled on a two-year rotational basis, with approximately half these wells being sampled in any given year. All wells in the network adhered to specific siting, depth, and construction criteria, and the network as a whole was deemed representative of the state's major aquifer systems. The program's surviving electronic database contains roughly 150,000 records spanning 120 different physical, chemical and radiological parameters and 327 groundwater quality monitoring locations. Additional background information is presented in the program's QAPP and accompanying set of SOPs, last revised in December 2000.

Some groundwater quality data continues to be gathered by KDHE through the efforts of its major regulatory bureaus. For example, groundwater is routinely sampled by the Bureau of Environmental Remediation from the vicinity of nearly 200 abandoned landfills and groundwater remedial sites, 1,500 storage tank cleanup sites, and a few active surface mining operations. The Bureau of Waste Management obtains groundwater quality information from a few dozen active landfills and hazardous waste sites across the state. The Bureau of Water requires a number of major NPDES permit holders to periodically submit data on groundwater quality; examples include larger confined animal feeding operations, certain industrial operations (e.g., meat processing facilities, power plants, injection wells), and a few municipal wastewater treatment plants. All of these monitoring activities focus on surficial groundwater and/or a very limited set of analytical parameters. Although public water supply systems are monitored for a wide range of parameters pursuant to the federal Safe Drinking Water Act, samples are collected after treatment and do not reliably reflect the condition of the raw water source. These assorted monitoring operations are not intended to provide representative information on the state's major aquifer systems or to serve as a coordinated and comprehensive ambient groundwater quality monitoring program. Tables 14 -17 summarize recent groundwater protection initiatives, contaminant concerns, and monitoring operations implemented in the state during this 305(b) reporting cycle.

Table 14. Summary of State Groundwater Protection Programs

Programs or Activities	Check (X)	Implementation Status	Responsible State Agency
Active SARA Title III program	X	fully established	KDHE*
Ambient groundwater monitoring		suspended	KDHE
Aquifer vulnerability assessment	X	ongoing	KDHE*
Aquifer mapping	X	fully established	KGS
Aquifer characterization	X	ongoing	KGS
Comprehensive data management	X	ongoing	KDHE
EPA-endorsed Core Comprehensive State Groundwater Protection Program	X	under review	KDHE
Groundwater discharge permits	X	fully established	KDHE
Groundwater Best Management Practices	X	fully established	KDHE
Groundwater quality standards		none	KDHE
Interagency coordination for groundwater protection initiatives	X	ongoing	KWO
NPS controls	X	fully established	KDHE*
Pesticide State Management Plan	X	pending EPA approval	KDA
Pollution Prevention Program	X	fully established	KDHE
RCRA Primacy	X	fully established	KDHE
Source Water Assessment Program (SWAP	X	fully established	KDHE
State Superfund	X	fully established	KDHE
State RCRA with more stringent requirements than RCRA Primacy	X	fully established	KDHE
State septic system regulations	X	fully established	KDHE
Underground Storage Tank (UST) installation requirements	X	fully established	KDHE
UST Remediation Fund	X	fully established	KDHE
UST Permit Program	X	fully established	KDHE
Underground Hydrocarbon Storage Well Program	X	fully established	KDHE
Underground Injection Control Program	X	fully established	KCC & KDHE
Vulnerability assessment for drinking water/wellhead protection	X	EPA approved plan implementation proceeding	KDHE
Well abandonment regulations	X	fully established	KDHE
Wellhead Protection Program (EPA-approved)	X	EPA approved plan implementation proceeding	KDHE
Well installation regulations	X	fully established	KDHE

*principal administrative agency

Table 15. Major Sources of Groundwater Contamination

Ten Highest Priority Contaminant Sources	Factors Considered in Selecting a Contaminant Source	Types of Contaminants
AGRICULTURAL ACTIVITIES: Ag. chemical facilities/applications	D,A,C	E,B,C
Animal feedlots	D,A,C	J,E
STORAGE AND TREATMENT: Storage tanks (AST/LUST)	C,D,B,A	D
Surface impoundments	E,A	J,E
DISPOSAL ACTIVITIES: Landfills/illegal dumping	E,C,A	H
OTHER: Active/abandoned industrial facilities	A,B,C	C,H,D
Oil and gas activities	D,A,B,C	D,G
Pipelines and sewer lines	E,A	D,E
Salt water intrusion	E,C,B	G
Spills	D,A	D,C

Factors Considered in Selecting a Contaminant Source:
(A) Human health and/or environmental risk (toxicity)
(B) Size of population at risk
(C) Location of sources relative to drinking water sources
(D) Number and/or size of contaminant sources
(E) Hydrogeologic sensitivity

Types of Contaminants:
(A) Inorganic pesticides
(B) Organic pesticides
(C) Halogenated solvents
(D) Petroleum compounds
(E) Nitrate
(F) Fluoride
(G) Salinity/brine
(H) Metals
(I) Radionuclides
(J) Bacteria
(K) Protozoa
(L) Viruses

Table16. Groundwater Contamination Summary. Statewide Cumulative Summary through December 31, 2005

Source Type	# of Kansas Sites	# of Sites with Confirmed	# with Confirmed Groundwater	Primary Contaminants	# of Site Assess-ments	# of Sites with Source	# of Sites with CAPs	# of Sites with Active	# of Sites with Cleanup
NPL	13	13	13	VOCs, metals	13	unavailable	0	10	5
CERCLIS (non-NPL)	82	82	10	VOCs, metals & PCBs	82	unavailable	1	66	56
DOD/FUDS	454	454	121	VOCs, metals,	454	unavailable	0	124	65
LUST	10,172	4,640	2,723	gasoline and diesel fuels	10,172	5,000	unavailable	422	7,983
RCRA Corrective Action	34	34	34	VOCs, metals & semi-volatiles					
Solid Waste Landfills	69	16	16	VOCs	16	not	5	5	0
Underground	32	0	0	-	0	0	0	0	0
Underground	10	0	0	-	0	0	0	0	465
State Sites **	1,410	1,4107	802	VOCs, metals,	1,410	unavailable	28	424	
NPS	unknown								

CAPs - Corrective Action Plans
CERCLIS - Comprehensive Environmental Response, Compensation, and Liability Information System (Includes non-NPL Management Assistance (CERCLA Lead and Supefund sites)
DOD/FUDS - Department of Defense/Formerly Used Defense Sites
LUST - Leaking Underground Storage Tanks
NPL - National Priority List
NPS - Non Point Source
RCRA - Resource Conservation and Recovery Act
* Represents Class I and III injection wells and hydrocarbon storage sites, but does not include Class II brine injection wells.
** Numbers do not include sites under KCC jurisdiction or LUST sites.

Table 17. Groundwater Monitoring Data Summary, 2002-2005

Monitoring Data Type	Sources	Total Samples	Parameter / Parameter Group	No Detects	Detects	Nitrate #5 mg/Ll	Nitrate >5 and #10 mg/Ll	Parameters Exceeding MCL	Sources Removed from Service
Untreated Water	26	216	VOC	109	107			6	4
	23	208	SOC	123	85			0	2
	29	220	EDB	217	3			2	4
	60	91	ARSENIC	18	73			0	15
	60	89	FLUORIDE	6	83			0	16
	58	85	MERCURY	85	0			0	15
	91	200	NITRATE	18	182	56	61	65	27
	62	89	SELENIUM	17	72			2	15
Finished Drinking Water	894	1317	VOC	1104	213			7	47
	891	1249	SOC	989	260			2	44
	894	1347	EDB	1309	38			8	47
	882	1179	ARSENIC	376	803			0	42
	888	1495	FLUORIDE	94	1401			4	43
	883	1181	MERCURY	1178	3			0	0
	1059	5215	NITRATE	522	4693	2956	1382	352	91
	885	1217	SELENIUM	162	1055			21	39

NOTES: (1) All data obtained from the Kansas Public Water Supply Monitoring Network
(2) Some wells and treatment plants may have been sampled more than once during the reporting period (2002-2005)
(3) Some samples may have occasional surface water under influence
(4) Some treatment plants may include a single or multiple sources
(5) Only parameters with federal drinking water MCLs were included in this summary
(6) Samples may have more than one organic parameter detected
(7) VOC = Volatile Organic Compound; SOC = Synthetic Organic Compound; EDB = Ethylene Dibromide

APPENDICES:

A. List of Parameters
B. Stream Chemistry and Microbiological Assessment Methodology
C. Clean Lakes Program (Section 314(a)) Assessment

Appendix A

List of Parameters

Stream Monitoring Program

Core Composite and Inorganic Parameters
Alkalinity, total (as $CaCO_3$)
Aluminum, total recoverable
Ammonia, total (as N)
Antimony, total recoverable
Arsenic, total recoverable
Barium, total recoverable
Beryllium, total recoverable
Boron, total recoverable
Bromide
Cadmium, total recoverable
Calcium, total recoverable
Chloride
Chromium, total recoverable
Cobalt, total recoverable
Copper, total recoverable
Dissolved oxygen
Fluoride
Hardness, total (as $CaCO_3$)
Iron, total recoverable
Kjeldahl nitrogen
Lead, total recoverable
Magnesium, total recoverable
Manganese, total recoverable
Mercury, total
Molybdenum, total recoverable
Nickel, total recoverable
Nitrate (as N)
Nitrite (as N)
Phosphate, ortho- (as P)
Phosphorus, total (as P)
Potassium, total recoverable
Selenium, total recoverable
Silica, total recoverable (as SiO_2)
Silver, total recoverable
Sodium, total recoverable
Specific conductance
Strontium, total recoverable
Sulfate
Thallium, total recoverable
Total dissolved solids (calculated)
Total organic carbon
Total suspended solids
Turbidity
Vanadium, total recoverable
Zinc, total recoverable

Core Microbiological Parameters
Escherichia coli (*E. coli*)

Field Measurements
pH
Temperature

Core Organic Parameters
2,4-D as acid
2,4,5-T as acid
2,4,5-TP as acid (Silvex)
Acetochlor
Alachlor
Aldrin
Atrazine (Aatrex)
Alpha-BHC
Beta-BHC
Delta-BHC
Gamma BHC (Lindane)
Butachlor
Carbofuron (Furadan)
Chlordane
Cyanazine (Bladex)
DCPA (Dacthal)
p,p'-DDD
p,p'-DDE
p,p'-DDT
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan Sulfate
Endrin
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
Hexachlorocyclopentadiene
Methoxychlor
Metolachlor (Dual)
Metribuzin (Sencor)
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248

Stream Program –continued

PCB-1254
PCB-1260
Picloram (Tordon)
Propachlor (Ramrod)
Propazine (Milogard)
Simazine
Toxaphene

Supplemental Organic Parameters
Chlorophyll-a
Chlorpyrifos (Dursban)
Deethylatrazine
Deisopropylatrazine
Diazinon
Pentachlorophenol
Pheophytin-a
Prometon

Supplemental Radiological Parameters
Actinium-228
Antimony-125
Barium-140
Beryllium-7
Cerium-141
Cerium-144
Cesium-134
Cesium-136
Cesium-137
Chromium-51
Cobalt-57
Cobalt-58
Cobalt-60
Gallium-67
Gross alpha
Gross beta
Gross uranium
Indium-111
Iodine-123
Iodine-131
Iodine-132
Iodine-133
Iron-59
Lanthanum-140
Manganese-54
Molybdenum-99
Neodymium-147
Neptunium-239
Niobium-95
Potassium-40
Radium-226
Ruthenium-103
Ruthenium-106
Silver-110m
Strontium-89
Strontium-90
Technetium-99m
Thorium-228
Total Solid
Tritium
Ytterbium-169
Zinc-65
Zirconium-95

Lake Monitoring Program

Core Composite and Inorganic Parameters
Alkalinity, total (as $CaCO_3$)
Aluminum, total recoverable
Ammonia, total (as N)
Antimony, total recoverable
Arsenic, total recoverable
Barium, total recoverable
Beryllium, total recoverable
Boron, total recoverable
Bromide
Cadmium, total recoverable
Calcium, total recoverable
Chloride
Chromium, total recoverable
Cobalt, total recoverable
Copper, total recoverable
Fluoride
Hardness, total (as $CaCO_3$)
Iron, total recoverable
Kjeldahl nitrogen
Lead, total recoverable
Magnesium, total recoverable
Manganese, total recoverable
Mercury, total
Molybdenum, total recoverable
Nickel, total recoverable
Nitrate (as N)
Nitrite (as N)
pH
Phosphate, ortho- (as P)
Phosphorus, total (as P)
Potassium, total recoverable
Selenium, total recoverable
Silica, total recoverable (as SiO_2)
Silver, total recoverable
Sodium, total recoverable
Specific conductance
Strontium, total recoverable
Sulfate
Thallium, total recoverable
Total dissolved solids (calculated)
Total organic carbon
Total suspended solids
Turbidity
Vanadium, total recoverable
Zinc, total recoverable

Core Microbiological Parameters
Escherichia coli (*E. coli*)

Core Organic Parameters
2,4-D as acid
2,4,5-T as acid
2,4,5-TP as acid (Silvex)
Acetochlor
Alachlor
Aldrin
Atrazine (Aatrex)
Alpha-BHC
Beta-BHC
Delta-BHC
Gamma BHC (Lindane)
Butachlor
Carbofuron (Furadan)
Chlordane
Cyanazine (Bladex)
DCPA (Dacthal)
p,p'-DDD
p,p'-DDE
p,p'-DDT
Deethylatrazine (breakdown product)
Deisopropylatrazine (breakdown product)
Dieldrin
Endosulfan I
Endosulfan II
Endosulfan Sulfate
Endrin
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
Hexachlorocyclopentadiene
Methoxychlor
Metolachlor (Dual)
Metribuzin (Sencor)
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260
Picloram (Tordon)
Propachlor (Ramrod)
Propazine (Milogard)
Simazine
Toxaphene

Lake Program –continued

Miscellaneous
Algal taxonomy*
Chlorophyll-a
Dissolved oxygen
Macrophyte abundance*
Phaeophytin-a
Photosynthetically active radiation (PAR)*
Secchi depth*
Temperature
Total inorganic carbon (by calculation)

Occasional Parameters (special projects)
Biological oxygen demand
Chemical oxygen demand
Zooplankton taxonomy*

*not chemical analyses

Fish Tissue Monitoring Program

Fillet Analysis

Core Inorganic Parameters
Cadmium
Lead
Mercury
Selenium

Core Organic Parameters
p,p'-DDD
p,p'-DDE
p,p'-DDT
Dieldrin
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
gamma-Hexachlorocyclohexane
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260
Pentachloroanisole
Technical Chlordane
  Oxychlordane
  cis-Chlordane
  trans-Chlordane
  cis-Nonachlor
  trans-Nonachlor
Trifluralin ((Treflan)

Wholefish Analysis

Routine Inorganic Parameters
Cadmium
Lead
Mercury
Selenium

Core Organic Parameters
1,2,4,5,-Tetrachlorobenzene
p,p'-DDD
p,p'-DDE
p,p'-DDT
Diazinon
Dieldrin
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
gamma-Hexachlorocyclohexane
Mirex
PCB-1248
PCB-1254
PCB-1260
Pentachloroanisole
Technical Chlordane
Trifluralin (Treflan)

Appendix B

Stream Chemistry and Microbiological Assessment Methodology

Background

Based on water quality data obtained by KDHE from January 2002 through December 2005, monitored streams in Kansas were classified as either fully supportive, partially supportive, nonsupportive, or threatened for each designated use presented in the November 5, 2004, edition of the Kansas surface water register. The overall level of use support was then calculated for the state's entire population of monitored streams and presented along with other relevant information in the 305(b) report.

Beneficial uses recognized by the State of Kansas and assessed as part of this analysis included aquatic life support, domestic water supply, food procurement, groundwater recharge, industrial water supply, irrigation, livestock watering, and primary and secondary contact recreation. Support determinations for individual stream reaches and associated designated uses were based on numeric water quality criteria set forth in the December 6, 2004, revision of the Kansas surface water quality standards (K.A.R. 28-16-28b et seq.). Where applicable, established low flow background concentrations for chloride, sulfate and fluoride were applied as numeric criteria pursuant to K.A.R. 28-16-28e(b)(a).

On July 7, 2003, pursuant to 40 CFR 131, EPA promulgated contact recreational uses for stream segments lacking recreational use designations in the Kansas surface water register. The designated uses promulgated by EPA were applied in this 305(b) assessment only if the affected stream reaches were not subsequently evaluated by KDHE and assigned recreational uses in the 2004 register.

Data Considerations

Stream monitoring sites yielding fewer than three bimonthly samples during this reporting cycle (including stations that were dry or pooled during much of this period) were not considered in the 305(b) assessment. Similarly, parameters monitored on fewer than three occasions at a given sampling location were excluded from this analysis. For monitoring sites yielding more than three but fewer than ten samples (40 out of 299 sites), the assessment period was extended back in time four years (to 1998) and the ten most recently collected samples were considered by KDHE.

The department applied several assumptions in the spatial application of stream physicochemical and microbiological data. Foremost among these was that each monitoring location effectively represented all state classified upstream segments within a 30-kilometer radius and all downstream mainstem segments within 15 kilometers. There were several exceptions to this rule:

1) If an upstream tributary segment extended outside the radius, the segment was considered monitored only if more than 50% of its length was within the radius.

2) If a (mainstem) segment originated within the "assessment reach" of a network station, and a significant portion (10-20%) fell within the assessment reach, then the entire segment was regarded as monitored unless point sources, impoundments, or

major tributary confluences outside the reach were expected to significantly influence water quality.

3) If a monitoring station occurred on a tributary within the assessment reach of a downstream (mainstem) station, use support determinations for the tributary were based on data from the tributary station.

4) If the separation distance between stations was less than 45 kilometers, use support summaries for overlapping assessment reaches were based on data from the downstream monitoring station. Such overlapping reaches generally occurred on larger streams.

5) Ditches, irrigation canals, major classified impoundments and their upstream segments were excluded from the assessment (except for Empire Lake, Cherokee County, due to a short hydrological residence time).

6) If a major (>1.0 MGD) sewage treatment plant discharged within the assessment area, the assessment began at the treatment plant outfall when the monitoring site was located below the point source, or ended at the treatment plant outfall if the monitoring site was above the point source.

7) If a major sewage treatment plant discharged into a stream and two network stations closely bracketed the outfall location, the outfall location served as the delineation point between upstream and downstream assessment reaches.

8) Best professional judgment was utilized to include or exclude segments within the assessment distance if these segments were largely intermittent or of much smaller stream order.

Use Support Determinations

In assigning a support category to a particular designated use, the department consistently considered the “worse case” water quality parameter. For example, if a stream segment complied during the reporting cycle with all but one of the criteria for the protection of the livestock watering use, the segment was deemed either partially supportive or nonsupportive of the use (depending on the severity of the pollution problem) and assigned to the “impaired” category for overall use support.

If a classified stream reach was considered either partially supportive or nonsupportive of a given use, the department considered the pollutants (causes) of concern and attempted to determine the most probable sources of these pollutants. Informational materials used in this analysis were derived from both KDHE and various other governmental agencies and institutions and included: (1) GIS coverages and related maps depicting prevailing land uses, crop type, grazing livestock densities, and the location of major urban areas, highways, major municipal and industrial point sources, and permitted and certified feedlot facilities; (2) other maps and related written materials addressing regional topography, geology, soil characteristics, and the location of major mineral intrusion areas, active and inactive oil and natural gas fields, surface and subsurface mines, permitted irrigation wells, and documented groundwater and/or soil contamination sites; and (3) miscellaneous reports and publications regarding stream flow, stream channelization and dredging practices, pesticide and fertilizer application practices and application rates, brine disposal practices, and storm water runoff quality.

Domestic Water Supply

Domestic water supply (DWS) use was assessed only if a point of DWS diversion occurred within the stream reach assigned to a monitoring site. In the evaluation of this use, all DWS parameters except nitrate, chloride and sulfate were assessed using the median (50^{th} percentile) concentration. For the latter parameters, the following approaches were used:

Nitrate (maximum contaminant level):

Fully supporting:	zero recorded exceedences
Nonsupporting:	one or more recorded exceedences

Chloride and sulfate (secondary contaminant levels):

Fully supporting:	exceedences $\leq$ 10% of observations
Partially supporting:	exceedences > 10% but $\leq$ 25% of observations
Nonsupporting:	exceedences > 25% of observations

Again, all other DWS parameters were assessed using median concentrations, in keeping with promulgated maximum contaminant levels predicated on lifetime exposures. If median concentrations fell below the analytical reporting limit (i.e., statistically "censored" data) and the number of individual censored values did not exceed 80% of all observations, the median concentration was estimated by the robust ROS (regression on order statistics) method (source: Helsel 2005). Use support determinations for stream reaches containing points of DWS diversion were based on the following conventions:

Fully supporting:	exceedences $\leq$ 50% of observations
Nonsupporting:	exceedences > 50% of observations

Aquatic Life Support

Given that contaminant levels in grab samples were not necessarily reflective of the average chemical concentrations occurring over longer (chronic) exposure periods, only conventional criteria and acute criteria were applied in this 305(b) assessment:

Conventional parameters (including dissolved oxygen, pH, temperature):

Fully supporting:	exceedences $\leq$ 10% of observations
Partially supporting:	exceedences > 10% but $\leq$ 25% of observations
Nonsupporting:	exceedences > 25% of observations

Toxicants (including heavy metals, priority pollutants, ammonia, chloride, pesticides):

Fully Supporting:	exceedences $\leq$ 1 observation
Partial Supporting:	exceedences > 1 observation and $\leq$ 10% of observations
Nonsupporting:	exceedences > 1 observation and > 10% of observations

Table B-1. Partitioning of aquatic life support levels based on the number of acute criterion exceedances

Full support	Partial support	Non-support
1/10		2/10
1/12		2/12
1/20	2/20	3/20
1/25	2/25	3/25
1/30	3/30	4/30
1/40	4/40	5/40
1/50	5/50	6/50
1/60	6/60	7/60

In assessing the overall level of aquatic life support for stream reaches subjected to both chemical and biological monitoring (see stream biological monitoring program discussion, this report), an integrated approach was employed by KDHE. Biological data were deemed a more direct measure of aquatic life support and, therefore, were generally given precedence over physical and chemical information. However, hypoxic conditions or unusually high pH levels sometimes pointed to water quality problems not readily or comprehensively reflected in the macroinvertebrate data. These occurrences were construed, in some instances, as evidence of aquatic life impairment. If the chemical and biological data differed in terms of assessment, the manager of the stream chemistry monitoring program, the manager of the stream biological monitoring program, and the section chief collectively assigned an aquatic life support level based on best professional judgment.

Irrigation

All parameters:

Fully Supporting: exceedences $\leq$ 10% of observations
Partial Supporting: exceedences > 10% but $\leq$ 25% of observations
Nonsupporting: exceedences > 25% of observations

Livestock Watering

All parameters:

Fully Supporting: exceedences $\leq$ 10% of observations
Partial Supporting: exceedences > 10% but $\leq$ 25% of observations
Nonsupporting: exceedences > 25% of observations

Food Procurement

Criteria listed under the food procurement use in table 1a of the Kansas surface water quality standards are meant to represent contaminant ceilings that protect against bioaccumulation and biomagnification of toxic pollutants in the food chain and any related public health problems. These criteria were applied in this report as median concentrations, as follows:

All parameters:

Fully supporting:	exceedences ≤ 50% of observations
Nonsupporting:	exceedences > 50% of observations

If the median concentration for a given stream reach was itself a censored value, and if the number of individual censored values (observations) used to derive the median did not exceed 80% of all observations, the median concentration was estimated by the robust ROS (regression on order statistics) method (source: Helsel 2005).

Contact Recreation

The revised water quality standard for primary contact recreation is based on *Escherichia coli* (*E. coli*), a single species in the fecal coliform group. The accompanying numeric criteria are predicated on a geometric mean of at least five separate samples collected in separate 24-hour periods during a 30-day assessment period. The department initiated a new bacteriological monitoring project on July 1, 2004, that met the aforementioned (geometric mean-based or GMB) monitoring requirements. This effort focused initially on the Arkansas and Kansas rivers, two of the state's larger, publicly owned, and publicly accessible streams.

Bacteriological information obtained through the bimonthly sampling of streams was insufficient for strictly assessing compliance with the state's new recreational criteria. For the purposes of this report, however, *E. coli* data from bimonthly sampling locations were partitioned according to the primary contact recreational seasons (November 1 through March 31; April 1 through October 31) and secondary contact recreational period (January 1 through December 31) and used as a screening tool for identifying impaired waters. Specifically, all stream reaches visited on a bimonthly basis and exhibiting geometric mean concentrations of *E. coli* in excess of the GMB regulatory threshold(s) were assigned a support level of "threatened but fully supportive" pending further investigation.

Primary Contact – GMB Network:

Fully supporting:	zero recorded exceedences of applicable criterion
Nonsupporting:	one or more recorded exceedences of applicable criterion

Geometric mean assessment window (April 1 – October 31):

Class B fully supporting:	≤ 262 colony forming units/100 mls
Class C fully supporting:	≤ 427 colony forming units/100 mls
Class B nonsupporting:	> 262 colony forming units/100 mls
Class C nonsupporting:	> 427 colony forming units/100 mls

Geometric mean assessment window (November 1 – March 31):

Class B fully supporting:	≤ 2358 colony forming units/100 mls
Class C fully supporting:	≤ 3843 colony forming units/100 mls
Class B nonsupporting:	> 2358 colony forming units/100 mls
Class C nonsupporting:	> 3843 colony forming units/100 mls

Secondary Contact – GMB Network:

Fully supporting:	zero recorded exceedences of applicable criterion
Nonsupporting:	one or more recorded exceedences of applicable criterion

Geometric mean assessment window (January 1 – December 31):

Class a fully supporting:	≤ 2358 colony forming units/100 mls
Class b fully supporting:	≤ 3843 colony forming units/100 mls
Class a nonsupporting:	> 2358 colony forming units/100 mls
Class b nonsupporting:	> 3843 colony forming units/100 mls

Primary Contact – Bimonthly Sampling Network:

Fully supporting:	seasonal geometric mean does not exceed applicable criterion
Threatened:	seasonal geometric mean exceeds applicable criterion

Geometric Mean Assessment Period (April 1 – October 31):

Class B fully supporting:	≤ 262 colony forming units/100 mls
Class C fully supporting:	≤ 427 colony forming units/100 mls
Class B threatened:	> 262 colony forming units/100 mls
Class C threatened:	> 427 colony forming units/100 mls

Geometric Mean Assessment Period (November 1 – March 31):

Class B fully supporting:	≤ 2358 colony forming units/100 mls
Class C fully supporting:	≤ 3843 colony forming units/100 mls
Class B threatened:	> 2358 colony forming units/100 mls
Class C threatened:	> 3843 colony forming units/100 mls

Secondary Contact – Bimonthly Sampling Network:

Fully supporting:	seasonal geometric mean does not exceed applicable criterion
Threatened:	seasonal geometric mean exceeds applicable criterion

Geometric Mean Assessment Period (January 1 – December 31):

Class a fully supporting:	≤ 2358 colony forming units/100 mls
Class b fully supporting:	≤ 3843 colony forming units/100 mls
Class a threatened:	> 2358 colony forming units/100 mls
Class b threatened:	> 3843 colony forming units/100 mls

References

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Appendix C

Clean Lakes Program (Section 314(a)) Assessment

(Note: Only information differing significantly from that presented in the 2004 314(a) assessment is addressed in this appendix.)

Background

A total of 321 publicly owned or publicly accessible lakes were assessed during this reporting cycle. This represents all such lakes known to KDHE through monitoring activities and reports published by other agencies. Collectively, these lakes comprise about 189,258 surface acres.

Lake Trophic Status

Most of the classified lakes in Kansas fall into the slightly eutrophic-to-hypereutrophic categories; however, the vast majority of lake surface acreage falls into the argillotrophic or slightly-to-fully eutrophic categories. This reflects the influence that lake size (area, volume, depth) exerts on lake trophic condition. Many of the larger lakes in Kansas are classified as mesotrophic-to-eutrophic or otherwise suffer from high turbidity. In contrast, many of the state's smaller lakes develop hypereutrophic conditions owing, in large part, to hydrological and morphometric factors. A significant percentage (13.4%) of the state's classified lakes have not been assessed with respect to trophic condition, but these waterbodies represent only 1% of the total reported lake acreage in Kansas.

Table 1. Categories of Data used in ALUS Assessments for Lakes

DEGREE OF ALUS (acute criteria only)	ACRES ASSESSED BASED ON BIOLOGICAL HABITAT DATA ONLY	ACRES ASSESSED BASED ON PHYSICAL/ CHEMICAL DATA ONLY	ACRES ASSESSED BASED ON BIOLOGICAL/ CHEMICAL DATA	TOTAL ACRES ASSESSED FOR ALUS
Insufficient data	0	0	0	2,320
Fully supported	0	0	102,113	102,113
Fully supported But Threatened			12,932	12,932
Partially supported	0	0	67,034	67,034
Not supported	0	0	4,859	4,859
Total Assessed	0	0	186,938	189,258

Table 2. Lake Acreage With Identifiable Point and Nonpoint Source Pollution

POLLUTION TYPE	NUMBER OF LAKES*	ACRES OF LAKES
Point Sources	29	146,416
Nonpoint Sources	234	175,099
No Identifiable Pollution Sources	87	14,159

*Numbers include any level of point source inputs, and any magnitude or combination of NPSs. Due to the fact that a number of lakes have both source types within their watersheds, the numbers will not necessarily total to the acres/numbers of lakes reported in this chapter.

Table 3. Trophic Status of Lakes Assessed during Reporting Cycle (% of total in parentheses)

TROPHIC STATUS	NUMBER OF LAKES	ACREAGE OF LAKES
Argillotrophic	16 (5.0)	41,865 (22.1)
Oligo-Mesotrophic	13 (4.0)	405 (0.2)
Mesotrophic	32 (10.0)	11,522 (6.1)
Slightly Eutrophic	44 (13.7)	55,541 (29.3)
Fully Eutrophic (Eutrophic)	61 (19.0)	60,368 (31.9)
Very Eutrophic	36 (11.2)	13,542 (7.2)
Low Hypereutrophic	38 (11.8)	1,657 (0.9)
High Hypereutrophic	38 (11.8)	1,726 (0.9)
Dystrophic	0	0
Unknown	43 (13.4)	2,632 (1.4)
TOTAL	321 (100.0)	189,258 (100.0)

Control Methods

(No new information to report.)

Restoration/Rehabilitation Efforts

(No new information to report.)

Impaired and Threatened Lakes

Table 4 summarizes the overall use support ratings for lakes assessed during this reporting cycle. Possible impairments related to violations of chronic aquatic life support criteria were not considered in this analysis Support ratings for individual designated uses are presented in Table 5.

Table 4. Summary of Fully Supporting, Threatened and Impaired Lakes (in acres)

DEGREE OF USE SUPPORT	ASSESSMENT CATEGORY		TOTAL ASSESSED
	EVALUATED	MONITORED	
Insufficient Data	2,095	225	2,320
Fully Supporting of all uses	1,086	26,814	27,900
Threatened for one or more uses (but not impaired any uses)	325	14,859	15,184
Size impaired for one or more uses	10,199	133,655	143,854
Total size assessed	**13,705**	**175,553**	**189,258**

The majority of lake surface acres in Kansas are considered to be monitored (Table 4). This is primarily due to the inclusion of all the federal impoundments within the KDHE lake and wetland monitoring network. These 24 lakes comprise the majority of the reported surface acreage in the state. All monitored lakes have data for a range of heavy metals, pesticides, and various other pollutants defined as toxic substances by EPA. Of the total reported lake acreage (189,258 acres), 175,553 acres were surveyed during this reporting cycle for total recoverable metals and pesticides (92.8%). Of the total acres assessed for toxic substances, 23,169 acres (12.2% of total) demonstrated some level of impairment due to metals or pesticides. Table 6 identifies the leading causes of lake use impairments in Kansas. Table 7 lists the major contaminant sources responsible for these impairments.

Table 5. Individual Use Summary for Lakes (in acres)

GOALS	USE	SIZE ASSESSED	SIZE FULLY SUPPORTING / SIZE THREATENED	SIZE PARTIALLY SUPPORTING	SIZE NOT SUPPORTING	INSUFFICIENT DATA
Protect & Enhance Ecosystems	Aquatic Life (acute criteria)	189,258	102,113 / 12,932	67,034	4,859	2,320
Protect & Enhance Public Health	Fish Consumption**	189,258	185,816 / 0	671	531	2,240
	Shellfishing	*	*	*	*	*
	Primary Contact	189,258	45,714 / 21,552	115,599	4,073	2,320
	Secondary Contact	189,258	127,165 / 13,106	43,372	3,295	2,320
	Domestic Water Supply	189,258	36,104 / 21,685	87,539	41,610	2,320
Social & Economic Enhancement	Agricultural (irrigation)	189,258	140,731 / 22,502	15,211	8,494	2,320
	Agricultural (livestock)	189,258	145,547 / 22,506	15,226	3,659	2,320
	Cultural	*	*	*	*	*

* = category not applicable

** = based on fish consumption advisories and food procurement criteria

Acid Effects on Lakes

A total of 175,553 acres of lakes in Kansas were monitored or evaluated for pH, out of the 189,258 acres assessed during the 2000-2005 reporting period. A total of 5,314 acres were impacted by high pH during this period. In all cases, high summertime pH incidents were related to periods of intense phytoplankton or macrophytic productivity. Approximately 68 acres were impacted by low pH owing to spoil pile drainage from historical (inactive) coal mining operations.

Table 6. Total Assessed Lake Acres Impacted by Cause Categories

CAUSE CATEGORY	ACREAGE IMPAIRED	
	MAJOR	MODERATE/MINOR
Cause unknown	0	0
Unknown toxicity	-	-
Pesticides	112	4,888
Priority organics	-	-
Nonpriority organics	-	-
Metals	0	18,513
Ammonia	-	-
Chlorine	-	-
Other inorganics (boron or fluoride)	41	5,390
Nutrients/eutrophication	26,107	123,461
pH	547	4,835
Siltation	*	*
Organic enrichment/low DO	66	43,716
Salinity/TDS/chlorides	111	37,409
Thermal modifications	-	-
Flow alterations	448	3,621
Other habitat alterations	-	-
Pathogen indicators	0	0
Radiation	-	-
Oil and grease	-	-
Taste and odor**	28,080	*
Suspended solids***	42,784	16,838
Noxious aquatic plants	264	167
Total toxics	-	-
Turbidity***	42,784	16,838
Exotic species	0	8,000
Other: perchlorate	128	0

- Category applicable but available data/criteria are insufficient.
* Statewide problem but no direct measurements are available
** Reflects problems severe enough to request KDHE assistance. Most incidents go unreported.
*** Based on multiple metrics

Table 7. Total Lake Acres Impaired by Source Categories

SOURCE CATEGORY	CONTRIBUTION TO IMPAIRMENT	
	MAJOR	MODERATE/MINOR
Industrial Point Sources	-	-
Municipal Point Sources	25,627	120,789
Combined Sewer Overflows	-	-
Agriculture	49,798	108,209
Silviculture	-	-
Construction	-	-
Urban Runoff/Storm Sewers	413	12,083
Resource Extraction	0	1,201
Land Disposals	-	-
Hydromodification	3,533	5,990
Habitat Modification	-	-
Marinas	-	-
Atmospheric Deposition	0	627
Contaminated Sediments	-	-
Unknown Source	0	0
Natural Sources*	10,132*	30,656*
In-Lake Management Techniques**	254	45
Other (specify)	-	-

- Category applicable but available data are insufficient

* Refers mainly to in-lake ecophysiological processes, wind resuspension phenomena, and variations in weather with little background pollution loading from watersheds (except for instances of excessive waterfowl)

** Some in-lake management techniques (e.g., aerators; algal control efforts) can impair water quality in other ways

Trends in Lake Water Quality

Temporal trends in lake water quality in Kansas can be difficult to determine, given resource constraints and the monitoring program's rather economical (rotational) sampling design. Trophic condition remains the state's primary indicator of change in lake water quality. If a given lake was surveyed for trophic condition on at least three occasions during the past twenty-one years, then a designation of improving, degrading or stable condition was assigned to the lake for the purposes of this assessment. If a given lake lacked recent information on trophic

condition, or if the most recent data were more than eight years old, then a trend classification of "unknown" was assigned to the lake. Table 8 addresses trends in trophic condition identified during this assessment period.

Table 8. Trophic State Trends in Lakes (% of total in parentheses)

CATEGORY	NUMBER OF LAKES	ACREAGE OF LAKES
Assessed for Trends	321(100%)	189,258 (100%)
Improving	4(1.2%)	6,917(3.7%)
Stable	103 (32.1%)	115,906 (61.2%)
Degrading	36 (11.2%)	53,277 (28.2%)
Trend Unknown	178 (55.5%)	13,158 (6.9%)

Approximately 61% of the monitored lake acreage in Kansas has exhibited no change in trophic condition in recent years. About 28% has experienced a measurable increase in trophic state, and the remaining 4% has exhibited some improvement in trophic condition. Trends for 178 smaller lakes are not well known; however, these lakes collectively represent only 7% of the state's classified lake acreage.

Wetlands Water Quality Assessment

(Note: Only information differing significantly from that presented in the 2004 314(a) assessment is considered in this section.)

Extent of Wetland Resources

(No new data to report.)

Integrity of Wetland Resources

Of the 36 wetlands (55,969 acres) assessed during this reporting cycle, only eight (45,066 acres) were regarded as monitored systems. The remaining 28 waterbodies (10,903 acres) were classified as evaluated systems. Wetlands are designated in Kansas for secondary contact recreation, food procurement, aquatic life support and, rarely, other beneficial uses. Aquatic life support during this reporting period was evaluated primarily on the basis of compliance with acute criteria. Overall, 40 acres (<1%) of classified wetlands were deemed fully supportive of the aquatic life use, 5,037 acres (9%) were deemed partially supportive, 41,810 acres (75%) were deemed nonsupportive, and the remaining 9,082 acres (16%) lacked sufficient data for a meaningful aquatic life assessment. Although these figures were based primarily on violations of the acute criteria, the totals for the various support categories were similar if chronic criteria were considered. With respect to the secondary contact recreational use, 104 wetland acres (<1%) were deemed fully supportive, 6,034 acres (11%) were deemed partially supportive, 40,749 acres (73%) were deemed nonsupportive, and 9,082 acres (16%) lacked sufficient data. Support levels for the food procurement use were as follows: 43,592 acres (78%) were fully

supportive, 3,295 acres (6%) were partially supportive, and 9,082 acres (16%) lacked sufficient data.

Major causes of water quality impairments in wetlands included excessive nutrients, heavy metals, salinity, elevated pH, flow alterations, low dissolved oxygen, and turbidity/siltation. Major sources included agriculture, hydromodifications, and natural phemomena such as wetland ecophysiological processes and natural variations in weather. During the reporting cycle, 41,845 wetland acres (74.5%) were assessed as hypereutrophic, 429 acres (0.8%) were assessed as slightly-to-very eutrophic, 41 acres (0.1%) were assessed as mesotrophic, and 9,082 acres (16.2%) were not assessed for trophic state. Another 4,572 acres were assessed as argillotrophic. Trends in trophic condition were as follows: 52% of the monitored acres were stable over time, 27% were degrading over time, and about 4% exhibited improvements in trophic condition. Available data did not permit the assessment of trends in 17% of the monitored wetland acres.

Development of Wetland Water Quality Standards

(No new information to report.)

Additional Wetland Protection Activities

(No new information to report.)